

## **REMARKS**

In view of the following remarks, Applicant respectfully requests favorable reconsideration of this application.

Claims 1-18 were pending in this application. No amendments to the specification or claims are submitted herewith.

The Office rejected claims 1-6 under 35 U.S.C. 102(e) as being anticipated by Tachikawa. The Office further rejected claim 7 under 35 U.S.C. 103(a) as obvious in view of Tachikawa. The Office further rejected claims 1-8, 13, and 16-18 under 35 U.S.C. 103(a) as obvious over Gee in view of Tachikawa. The Office further rejected claims 1-7 and 9-18 under 35 U.S.C. 103(a) as obvious over Tange in view of Tachikawa.

In each of the above-noted rejections, the Office relies on Tachikawa for teaching a zone of interstitial oxygen concentration of less than  $3 \times 10^{17}$  atoms/cm<sup>3</sup>. Particularly, Tachikawa is alleged to disclose a silicon semiconductor substrate having a zone of reduced oxygen concentration of, for example,  $3.5 \times 10^{16}$  atoms/cm<sup>3</sup> at a depth of 1 mm (or 1000 microns), referring to Table 2 in Tachikawa. The Office reasoned that, if Tachikawa's substrate has such a concentration of oxygen atoms at 1000 microns, it must have the same concentration at all depths less than 1000 microns, including the depths recited in the various claims of applicant, namely, 75 microns (claim 1), 100 microns (claim 2), 125 microns (claim 3), 150 microns (claim 4), 175 microns (claim 5), and presumably 200 microns (claim 6) although the last was not specifically mentioned in the Office Action.

Applicant respectfully traverses. While column 9 of Table 2 in Tachikawa does indeed refer to “[O<sub>i</sub>] at 1 mm depth ( $10^{16}$  atoms/cm<sup>3</sup>)”, the printed term “mm” clearly is a typographical error and should have been “μm” (which is shorthand for microns) inasmuch as a denuded zone 1000 microns thick would be ridiculous. All or virtually all semiconductor substrates are not even 1000 microns thick in their entirety.

The fact that this is a typographical error is not only apparent from the fact that a 1000 micron thick denuded zone is preposterous, but also from the specification of Tachikawa itself. Please note the following facts:

- (1) Column 9 of Tables 3 and 4 of Tachikawa are correctly labeled with the legend “[O<sub>i</sub>] at 1 μm depth ( $10^{16}$  atoms/cm<sup>3</sup>)” (emphasis added) (although it is conceded that Tables 5 and 6 also contain the same typographical error as Table 2).
- (2) Tachikawa is replete with references in the text of the specification (outside of the Tables) with references to the fact that the whole point of Tachikawa is to produce a semiconductor with a denuded zone of less than  $7 \times 10^{16}$  atoms of oxygen/cm<sup>3</sup> at a depth of 1 μm, not 1 mm, and Tables 2-6 are intended to show that.

See for instance:

- (a) Paragraph 30 (“After the semiconductor substrate is heat treated ... the semiconductor substrate acquires an oxygen concentration of not more than  $7 \times 10^{16}$  atoms/cm<sup>3</sup> at a depth of 1 μm from the surface at the center of the substrate ... .”;

- (b) Paragraph 35 (“The silicon semiconductor substrate manufactured by the method of production according to this invention secures a COP DZ of a thickness of not less than 5  $\mu\text{m}$ , excels in the capacity for gettering impurities, and satisfies the relational expression (1) when the oxygen concentration at a depth of 1  $\mu\text{m}$  from the surface at the center of the wafer thereof is not more than  $7 \times 10^{16}$  atoms/ $\text{cm}^3$ ”), paragraph 41 (“Subsequently, the silicon single crystal wafers thus obtained were evaluated as to the depth of a fault-free layer. ... The removal of the surface layer by the regrinding was effected to a varying depth of 1, 3, 5, 7, or 12  $\mu\text{m}$ .”);
- (c) Paragraph 51 (“Here, the data of Table 2 and Table 3 concern examples of the product of this invention having a diameter of 6 inches. These examples pertain to silicon semiconductor substrates satisfying the parameters of the present invention. That is, these silicon semiconductor substrates satisfy the condition that the cooling speed be not less than  $5^\circ \text{C./min}$  and the nitrogen concentration be not less than  $5 \times 10^{14}$  atoms/ $\text{cm}^3$ , the heat treatment be carried out in a non-oxidizing atmosphere at a temperature of not less than  $1150^\circ \text{C}$ . for a duration of not less than one hour, and the oxygen concentration at a depth of 1  $\mu\text{m}$  from the surface layer after the heat treatment be not more than  $7 \times 10^{17}$  atoms/ $\text{cm}^3$  as measured by SIMS”);
- (d) Paragraph 56 (“Further, the data of Table 5 concerns products of the examples of this invention having a diameter of 8 inches and these products are silicon semiconductor substrates. That is, the conditions that the cooling speed be not less than  $1^\circ \text{C./min}$  and less than  $5^\circ \text{C./min}$ , that the nitrogen concentration in

the silicon semiconductor substrate prior to the heat treatment be not less than  $1 \times 10^{15}$  atoms/cm<sup>3</sup>, that the heat treatment be carried out in a non-oxidizing atmosphere at a temperature of not less than 1200° C. for a duration of not less than one hour, and that the oxygen concentration at a depth of 1 μm from the surface layer subsequent to the heat treatment be not more than  $7 \times 10^{17}$  atoms/cm<sup>3</sup> in the measurement by the SIMS are satisfied.”); and

(e) Claims 3 and 4.

Note specifically paragraph 51, which discussed the data in Tables 2 and 3 collectively as if the two tables showed the same data, which would be true only columns 9, 10, 11, 12, and 14 of both tables showed the same data (rather than Table 2 referring to mm and Table 3 referring to μm). Also note that paragraph 51 states that these tables show that the substrates satisfy the condition of having an oxygen concentration at a depth of 1 m from the substrate surface layer after the heat treatment of not more than  $7 \times 10^{17}$  atoms/cm<sup>3</sup>, which, of course, would make little sense if column 9 of Table 2 actually showed oxygen concentration at a depth 1000 times the depth of interest.

Since all of the rejections rely on Tachikawa for a teaching that it actually does not contain, all of the rejections fail. Specifically, claim 1 recites “said structure comprising at least one zone of reduced oxygen concentration, said zone of reduced oxygen concentration having an interstitial oxygen concentration of not greater than  $3 \times 10^{17}$  oxygen atoms/cm<sup>3</sup>, said zone of reduced oxygen concentration including said first major surface and all points in said structure which are within 75 microns of said first major surface”.

All other claims depend from claim 1 and, therefore, distinguish over the prior art of record for at least the same reasons.

Applicants respectfully request the Office to issue a Notice of Allowance at the earliest possible date. The Examiner is invited to contact Applicants' undersigned counsel by telephone call in order to further the prosecution of this case in any way.

Respectfully submitted,

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Date

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